(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 313 766 B1**

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **09.03.94**

(51) Int. Cl.5: **A41B 13/04**, A61F 13/15, B32B 5/02, B32B 27/12

(21) Application number: **88114390.3**

(22) Date of filing: **02.09.88**

(54) Method and apparatus for preparing textured apertured film.

(30) Priority: **03.09.87 US 92862**

(43) Date of publication of application: **03.05.89 Bulletin 89/18**

(45) Publication of the grant of the patent: **09.03.94 Bulletin 94/10**

(84) Designated Contracting States: **AT BE CH DE ES FR GB GR IT LI LU NL SE**

(56) References cited:
DE-A- 2 730 756
US-A- 4 272 473
US-A- 4 463 045
US-A- 4 690 679

(73) Proprietor: **McNEIL-PPC, INC.**
One Johnson & Johnson Plaza
New Brunswick, New Jersey 08933(US)

(72) Inventor: **Cabe, Alex W., Jr.**
3 Muierfield Lane
Labanon, N.J. 08833(US)
Inventor: **Sampson, Arthur J.**
R.D. 1, Blackwell Mills Rd.
Belle Meade, N.J. 08502(US)
Inventor: **Saffel, Robert W.**
124 Dey Street
Hightstown, N.J. 08520(US)

(74) Representative: **Strehl Schübel-Hopf Groening & Partner**
Maximilianstrasse 54
D-80538 München (DE)

EP 0 313 766 B1

Description

This invention relates to apertured plastic films for use in absorbent products and, more specifically, to a method for imparting a desirable appearance and texture to such film.

Background

Absorbent products such as diapers, sanitary napkins and the like generally include a liquid permeable cover on one surface which may be fabric or apertured film. The purpose of the cover is to structurally contain the loosely packed absorbent material which comprises the bulk of the absorbent product, and to protect the body from direct contact with the absorbent material. The cover is preferably nonabsorbent so that the surface of the cover maintains a dry feel while fluids pass through the cover into the absorbent core. Since the cover material is in direct contact with the body, it should be smooth, soft and comfortable to the touch. Certain visual characteristics such as color, lustre, and texture are also important to consumer acceptance and satisfaction.

Apertured films of polypropylene and polyethylene have been widely used as cover materials for absorbent products since these films are inexpensive, nonabsorbent and readily produced. A particularly preferred material for use as a cover is a coextruded film of polyethylene and ethylene vinyl acetate (EVA) as described in U.S. Patent No.4,690,679. The polyethylene side of the film which is used as the body contact side, has a higher melting point than the EVA side of the film which permits the film to be thermally bonded while maintaining structural integrity. The outer polyethylene component of the film may be delustred with calcium carbonate while the EVA component may be pigmented with TiO_2 to increase the opacity of the film.

The polyethylene, coextruded polyethylene/EVA or other polymeric film is impervious to liquids as produced, and must be perforated or otherwise apertured for use as a liquid permeable cover material. The film may be perforated by known methods such as needle punching, pin perforating, embossing and stretching, or roll forming as disclosed in U.S. Patent No. 4,690,679. Alternatively, the film may be extruded with a solid particulate component which is subsequently removed from the film by stretching and/or mechanical or chemical means. These and other methods may be utilized to produce an apertured, liquid permeable film for use as a cover material on absorbent products.

US-A-4 463 045 relates to a process for producing three-dimensional plastic webs with a non-glossy surface and/or cloth-like or fiber-like tactile impression, wherein the film is debossed and, if desired, perforated by the use of heat and vacuum. The plastic film is macroscopically expanded three-dimensionally by directing hot air against one surface of the film while applying different levels of vacuum adjacent to the opposite surface of the film. The debossing/perforating cylinder is fluid pervious and may comprise a relative thin laminate structure provided with a microscopic pattern of surface aberrations. The film can either be macroembossed and apertured followed by microembossing while being still supported by the macroembossing roll or first microembossed followed by macroembossing and then apertured.
While the process of this reference gives a film with an appropriate non-glossy surface and cloth-like or fiber-like tactile impression, the need of a vacuum mechanism makes it expensive not only in energy but also in costs for equipment.

US-A-4 272 473 concerns a method of embossing a plastic film with cone-shaped bosses and perforating the apex of each cone. The thus produced film can be used as a barrier layer which allows liquid to pass through in one direction and prevents passage back in the other direction, but allows vapor to pass in either direction.
This prior art film has the drawbacks mentioned below, that is lack of aesthetics, a plastic feel and/or a certain degree of roughness and may be sticky or uncomfortable in contact with the skin of the user.

Apertured films as produced by the aforementioned methods have the desired liquid permeability and other functional properties, but are often lacking in aesthetics. In particular, these films may retain the "plastic" feel characteristic of polymeric films, and may be sticky or uncomfortable in contact with the skin of the user. Moreover, some methods of perforation may impart a certain degree of roughness to the surface of the film which further decreases comfort and consumer acceptance. In this regard, certain nonabsorbent but liquid permeable woven and nonwoven fabrics have superior softness and comfort as compared to apertured films.

It is accordingly an object of the present invention to provide a film having improved softness and hand with certain textile like properties. It is a further object of this invention to provide an apertured film having improved comfort and consumer acceptance when used as the liquid permeable cover on absorbent products. It is a yet further object of this invention to provide a method and apparatus for modifying apertured film in order to enhance the texture and physical properties thereof. These and other objects of this invention will be apparent from the ensuing description and claims.

Summary

In accordance with the preferred method of the present invention, apertured film for use as a cover material for absorbent products is subjected to a dual embossing process wherein the film is first macro embossed to expand the film out of the plane of the film in the thickness or Z-direction and impart a pronounced pattern to the surface of the film, and thereafter micro embossed with a finely engraved finish roll to flatten the structure into a thin, smooth film and impart a matte finish to the film while retaining the textile imprint of the macro embossing. The resulting product is a substantially two dimensional film having a smooth textured surface, low gloss and improved hand and softness.

In an alternate embodiment, the order of embossing may be reversed wherein the apertured film is first embossed with the micro embossing roll followed by macro embossing. The resulting product retains the micro embossed matte finish, but is highly expanded in the Z-direction following the macro embossing. The film accordingly has considerably greater loft or bulk than the macro-micro embossed film and may be preferred for certain end use applications.

The doubly embossed film retains its structural integrity and can be processed and assembled on absorbent products using conventional methods and equipment. The embossing reduces average hole size but increases hole size distribution which may be advantageous for certain applications. The processed film has improved hand, appears softer and less "plastic" by subjective tests and is more comfortable in contact with the body.

Description of Drawings

Figure 1 schematically illustrates the dual embossing process of the present invention.

Figures 2, 3 and 4 are enlarged plan views of various embossing patterns which may be utilized on a macro roll.

Figures 5, 6 and 7 are enlarged plan views of various embossing patterns which may be utilized on the micro embossing roll.

Figure 8 is an enlarged photograph of the surface of a preferred apertured film before embossing.

Figure 9 is an enlarged photograph of the surface of the same apertured film after embossing.

Description of the Invention

In accordance with a preferred method of the present invention, a supply of apertured film, preferably in the form of rolled goods, is processed through a dual embossing station, substantially as illustrated in Figure 1. Apertured film 10, such as that obtained by the process of U.S. Patent No. 4,690,679, is fed from roll 11, over idler roll 12, to the first embossing station comprising macro embossing roll 13 and rubber coated anvil roll 14. Embossing roll 13 is a steel roll having a pronounced embossing pattern such as the textile-like patterns illustrated in Figures 2-4, where Figure 2 illustrates a cross-dash pattern, Figure 3 illustrates a basket-weave pattern, and Figure 4 illustrates a herringbone pattern. Anvil roll 14 is a steel roll having a rubber sleeve to provide a resilient backing surface for the embossing roll. Rolls 13 and 14 are individually driven at synchronized speeds to draw film 10 off roll 11. Embossing roll 13 is heated and forced against anvil roll 14 under controlled pressure, the optimum temperature and pressure being dependent upon the thickness and composition of the film and the embossing speed. Specific operating conditions are best determined experimentally for each particular film. If embossing conditions are too mild, i.e. temperature and/or pressure too low, the film will be insufficiently embossed and the desired deformation and pattern definition will not be obtained. If conditions are too severe, i.e. temperature and/or pressure too high, there will be excessive plastic flow resulting in extreme thinness and possibly holes in the land areas of the embossed film. In general, an embossing temperature greater than about 65.56 °C (150 °F) will be used for polyolefin films.

While the macro embossing rolls preferably have a textile-like pattern, it will be understood that any macro embossing pattern comprising a multiplicity of projections in a regular or random pattern may be utilized according to the desired appearance of the final product. Each projection preferably has a face comprising a planer area, referred to herein as a "land", and the projections may comprise two or more contiguous lands forming, for example, a chevron, right-angle or grid-type configuration. Since the film is stretched in the Z-direction during the embossing process, sufficient free area between lands must be provided to avoid overstressing and rupturing the film. While the minimum required free area will depend to some extent on the thickness and composition of the film, as well as on the height of the projections, in most cases the free area should comprise from 0.5 to 10 times the land area, and most preferably from 1 to 7 times the land area. Greater proportions of free area can be provided of course, but the embossing is less effective if the land area is substantially less than 10 percent of the total surface area of the roll.

Apertured polymeric film for use as a cover material for absorbent products generally has a

thickness of from about 0.025 to 0.762 mm (1 to 30 mils), and most preferably from about 0.076 to 0.254 mm (3 to 10 mils). The projections on the macro embossing roll preferably have a height of at least 0.3 mm, and most preferably from 0.5 to 1.0 mm. The projections are preferably tapered inwardly from the base to the land in order to reduce stress on the film during the embossing process. In this regard, the macro embossing rolls of the present invention conform to conventional practice for rolls intended to emboss plastic film.

Film leaving the macro embossing station is preferably passed through a chiller and around tensioning rolls before moving on to the micro embossing station. The chiller, illustrated schematically in Figure 1, may consist of cooled rolls or a cool air stream and preferably reduces the film temperature to less than about 37.78°C (100°F) before the film contacts idler roll 16. The cooled film passes around tensioning roll 17 and idler roll 18 before feeding into the micro embossing station comprising embossing roll 19 and anvil roll 20. Rolls 19 and 20 are independently driven by synchronous means which respond to the position of tensioning roll 17 in order to assure constant tension with uniform feed between the two embossing stations. The micro embossing roll 19 is a steel roll engraved with a fine pattern such as that illustrated in Figures 5-7. Anvil roll 20 is a steel roll with a nylon sleeve which forms a firm backing surface for the micro embossing roll. Embossing roll 19 is heated and forced against the anvil roll at a temperature and pressure determined by the thickness and composition of the film, the nature of the pattern imparted by the macro embossing station, and the speed of the operation. Optimum processing conditions are best determined experimentally for each operation.

The micro embossing rolls are provided with a finely engraved or otherwise suitably prepared surface to impart a matte finish to the film. As illustrated in Figure 5, one suitable embossing pattern comprises a series of parallel lines angled to the major axis of the roll with from about 2 to 20 lines per millimeter and each line cut to a depth of about 0.03 mm, this pattern being known in the art as a Schreiner pattern. Figure 6 illustrates a cross-cut pattern of intersecting lines at a 45° angle, and similar patterns of intersecting lines forming angles of 15° to 75° with the major axis of the roll may be used. Figure 7 illustrates a granular surface which may have regular or random projections and indentations formed by mechanical, chemical or electrochemical processing. In all these rolls, the desired effect is obtained if the surface texture of the roll is sufficient to impart a matte finish to the film during the micro embossing process.

Upon leaving the micro embossing station, the film passes through chiller 21, over idler roll 22, around tensioning roll 23, and onto windup 24. Chiller 21 preferably comprises refrigerated steel rolls to cool the film to about room temperature before the film is collected on windup 24.

The process of the present invention is further illustrated by the following example wherein the starting material was a coextruded apertured film comprising polyethylene and ethylene vinyl acetate as disclosed in U.S. Patent No. 4,690,679. The film had an average open area of about 42%, a thickness of about 0.114 mm (4.5 mils), and a weight of about 33.91 g/m^2 (1 oz. per sq. yard). The apertures had an average equivalent circular diameter of about 0.406 mm (0.016 inches) and an average center-to-center spacing of about 0.711 mm (0.028 inches).

The apertured film was fed to the macro embossing station with the polyethylene side facing the steel embossing roll and the EVA side against the anvil roll. The speed of the macro embossing rolls was set at about 54.86 m/min (60 yds. per minute (ypm)) and roll nip pressure was about 39.4 kN/cm (225 lbs. per linear inch (pli)). The embossing roll had a cross-dash pattern corresponding to that illustrated in Figure 2 with a projection height of 0.7 mm. The ratio of free area to land area was about 4:1. The roll was heated to a temperature of about 76.67°C (170°F). The anvil roll was covered with 12.7 mm (1/2 inch) smooth rubber having a hardness value of about 60° on the Shore A scale. During operation, the anvil roll was not cooled and the surface temperature of this roll increased to about 46.11°C (115°F).

After macro embossing, the film was cooled to room temperature and rewound. The film was subsequently processed through the micro embossing station at a speed of 86.87 m/min. (95 ypm)under a nip pressure of 87.5 kN/m (500 pli). The micro embossing roll was engraved with the linear pattern illustrated in Figure 3 cut to a depth of 0.03 millimeters, and was heated to 76.67°C (170°F). The anvil roll was covered with a smooth, 25.4 mm (1 inch) nylon sleeve having a hardness of about 100° on the Shore A scale. During operation, the anvil roll was not cooled and reached a surface temperature of about 36.11°C (97°F). The resulting film was subsequently cooled to room temperature and collected on a rewind roll.

The apertured film which formed the starting material in the above example is illustrated in Figure 8 which is a photograph of the film surface enlarged 5x. The product resulting from the above example is illustrated in Figure 9 which is also a surface photograph illustrated 5x. The change in film texture which is readily visible in the photographs translates into a significant improvement

in hand, appearance, softness, comfort against the skin, and consumer acceptance when used as a cover material for absorbent products.

The preceding description and examples are directed to a preferred embodiment of the present invention, and many variations therein are possible and within the scope of the invention. For example, a variety of embossing patterns may be utilized on the macro embossing roll other than those illustrated in Figures 2-4. Any embossing roll which imparts a pronounced pattern to the film without rupturing the film can be used with good results, the important consideration being that the macro embossing process should expand the film at least about 2x in the Z-direction and impart a distinct and visually pleasing pattern.

The micro embossing roll may likewise comprise patterns other than those illustrated in Figure 5-7, the important consideration being that the micro embossing roll has a pattern which imparts a low sheen matte finish to the plastic film, thereby enhancing its smoothness and visual appearance. In a less preferred embodiment, micro embossing roll 19 may be a smooth roll, although this results in a higher gloss and diminished textile-like appearance in the finished product.

These and other variations will be apparent to those skilled in the art, and the present invention is accordingly not limited except by the claims appended hereto.

Claims

1. Process for manufacturing an apertured polymeric film with improved surface texture and softness comprising
   a) feeding an apertured polymeric film in a plane defined by X- and Y-directions from a roll (11) to a macro embossing roll (13) with a pronounced embossing pattern, said embossing roll (13) being heated and forced against an anvil roll (14) under controlled pressure to expand the film in Z-direction and impart a pronounced pattern to said film,
   b) cooling said macro embossed film in a chiller (15) to a temperature less than 37.7 °C (100 °F),
   c) feeding the macro embossed apertured film to a micro embossing roll (19) which is heated and forced against an anvil roll (20) under controlled pressure, and
   d) cooling the resulting film in a chiller (21) to a temperature less than 37.7 °C (100 °F) and collecting it on a rewind roll (24).

2. Process for manufacturing an apertured polymeric film with improved surface texture and softness comprising
   a) feeding an apertured polymeric film in a plane defined by X- and Y-directions from a roll (11) to a micro embossing roll (13), said embossing roll (13) being heated and forced against an anvil roll (14),
   b) cooling said micro embossed film in a chiller (15) to a temperature less than 37.7 °C (100 °F),
   c) feeding the micro embossed apertured film to a macro embossing roll (19) which is heated and forced against an anvil roll (20) under controlled pressure to impart a pronounced pattern to said film, and
   d) cooling the resulting film in a chiller (21) to a temperature less than 37.7 °C (100 °F) and collecting it on a rewind roll (24).

3. Process according to claim 1 or 2, wherein said apertured polymeric film is expanded in the Z-direction to at least twice its original unit thickness by said macro embossing step.

4. Process according to claim 1 or 2, wherein said apertured polymeric film has an original unit thickness of from 0.025 to 0.762 mm (1 to 30 mils).

5. Process according to claim 4, wherein said apertured polymeric film has an original unit thickness of from 0.076 to 0.254 mm (3 to 10 mils).

6. Process according to any one of claims 1 to 4, wherein said apertured polymeric film is selected from the group consisting of polypropylene, polyethylene and bicomponent polyethylene/ethylene vinyl acetate.

7. Process according to claim 1 or 2, wherein said apertured polymeric film comprises polyethylene and said macro and micro embossing temperature is greater than about 65.56 °C (150 °F).

8. Process according to claim 7, wherein said apertured polymeric film is coextruded polyethylene/vinyl acetate having a thickness of about 0.114 mm (4.5 mils) and an average open area of about 40 %.

9. Process according to claim 8, wherein the speed of the macro embossing roll is set at about 54.86 m/min (60 yards per minute), the roll nip pressure is about 39.4 kN/m (225 pounds per linear inch) and the temperature of the roll is about 76.67 °C (170 °F); and
   the speed of the micro embossing roll is about

86.87 m/min (95 yards per minute), the roll nip pressure is about 87.5 kN/m (500 pounds per linear inch) and the temperature of the roll is about 76.67 °C (170 °F).

10. Process according to any one of claims 1 to 9, wherein said pronounced pattern is a textile-like pattern selected from the group consisting of cross-dash, herring-bone and basket weave patterns.

11. Process according to any one of claims 1 to 10, wherein said micro embossing roll comprises an engraved linear pattern.

Patentansprüche

1. Verfahren zur Herstellung eines gelochten Polymerfilms mit verbesserter Oberflächentextur und Weichheit, umfassend
   (a) das Zuführen eines gelochten Polymerfilmes in einer Ebene, die durch die X- und Y-Richtung definiert wird, von einer Walze (11) zu einer Makroprägewalze (13) mit einem ausgeprägten Prägemuster, wobei die Prägewalze (13) erwärmt und mit kontrolliertem Druck gegen eine Amboßwalze (14) gepreßt wird, um den Film in Z-Richtung zu expandieren und diesem Film ein ausgeprägtes Muster zu verleihen,
   (b) das Abkühlen des makrogeprägten Filmes in einem Kühler (15) auf eine Temperatur von weniger als 37,7 °C (100 °F),
   (c) das Zuführen des makrogeprägten gelochten Filmes zu einer Mikroprägewalze (19), die erwärmt ist und mit kontrolliertem Druck gegen eine Amboßwalze (20) gepreßt wird und
   (d) Abkühlen des resultierenden Filmes in einem Kühler (21) auf eine Temperatur von weniger als 37,7 °C (100 °F) und sein Aufnehmen auf einer Aufwickelwalze (24).

2. Verfahren zur Herstellung eines gelochten Polymerfilms mit verbesserter Oberflächentextur und Weichheit, umfassend
   (a) das Zuführen eines gelochten polymeren Films in einer Ebene, die durch die X- und Y-Richtungen definiert wird, von einer Walze (11) zu einer Mikroprägewalze (13), wobei die Prägewalze (13) erwärmt wird und gegen eine Amboßwalze (14) gedrückt wird,
   (b) das Abkühlen des mikrogeprägten Filmes in einem Kühler (15) auf eine Temperatur von weniger als 37,7 °C (100 °F),
   (c) das Zuführen des mikrogeprägten gelochten Filmes zu einer Makroprägewalze (19), die erwärmt ist und unter kontrolliertem Druck gegen eine Amboßwalze (20) gepreßt wird, um diesem Film ein ausgeprägtes Muster zu verleihen und
   (d) das Abkühlen des Films in einem Kühler (21) auf eine Temperatur von weniger als 37,7 °C (100 °F) und sein Aufnehmen auf einer Aufwickelwalze (24).

3. Verfahren nach Anspruch 1 oder 2, worin der gelochte Polymerfilm mittels dem Makroprägeschritt in der Z-Richtung auf mindestens das zweifache seiner ursprünglichen Stärke expandiert wird.

4. Verfahren nach Anspruch 1 oder 2, worin der gelochte Polymerfilm eine ursprüngliche Stärke von 0,025 bis 0,762 mm (1 bis 30 mils) aufweist.

5. Verfahren nach Anspruch 4, worin der gelochte Polymerfilm eine ursprüngliche Stärke von 0,076 bis 0,254 mm (3 bis 10 mils) aufweist.

6. Verfahren nach einem der Ansprüche 1 bis 4, worin der gelochte Polymerfilm ausgewählt ist aus der Gruppe bestehend aus Polypropylen, Polyethylen und einer Polyethylen/Ethylenvinylacetat-Bikomponente.

7. Verfahren nach Anspruch 1 oder 2, worin der gelochte Polymerfilm Polyethylen umfaßt und die Makro- und Mikroprägetemperatur größer ist als etwa 65,56 °C (150 °F).

8. Verfahren nach Anspruch 7, worin der gelochte Polymerfilm koextrudiertes Polyethylen/Vinylacetat mit einer Stärke von etwa 0,114 mm (4,5 mils) ist und eine durchschnittliche offene Fläche von etwa 40 % aufweist.

9. Verfahren nach Anspruch 8, worin die Geschwindigkeit der Makroprägewalze auf etwa 54,86 m/min (60 Yards pro Minute) eingestellt ist, der Druck im Walzenspalt etwa 39,4 kN/m (225 Pfund pro linearem Inch) beträgt und die Temperatur der Walze etwa 76,67 °C (170 °F) beträgt und die Geschwindigkeit der Mikroprägerolle etwa 86,87 m/min (95 Yards pro Minute) beträgt, der Druck im Walzenspalt etwa 87,5 kN/m (500 Pfund pro linearem Inch) ist und die Walzentemperatur etwa 76,67 °C (170 °F) beträgt.

10. Verfahren nach einem der Ansprüche 1 bis 9, worin das ausgeprägte Muster ein textilartiges Muster ausgewählt aus der Gruppe bestehend aus Kreuzstrich, Fischgrat und korbartigem Gewebemuster ist.

11. Verfahren nach einem der Ansprüche 1 bis 10, worin die Mikroprägewalze ein eingraviertes lineares Muster umfaßt.

Revendications

1. Procédé de fabrication d'une pellicule polymérique à ouvertures ayant une texture superficielle et une douceur améliorées, dans lequel
   a) on introduit une pellicule polymérique à ouvertures dans un plan défini par les directions X et Y à partir d'un cylindre (11) en direction d'un cylindre de macro-gaufrage (13) ayant un dessin de gaufrage prononcé, ledit cylindre de gaufrage (13) étant chauffé et forcé contre un cylindre enclume (14) sous une pression contrôlée pour dilater la pellicule dans la direction Z et lui donner un dessin prononcé,
   b) on refroidit ledit film macro-gaufré dans un dispositif de refroidissement (15) à une température inférieure à 37,7 °C (100 °F),
   c) on introduit la pellicule à ouvertures avec macro-gaufrage dans un cylindre de micro-gaufrage (19) qui est chauffé et forcé contre un cylindre enclume (20) sous une pression contrôlée, et
   d) on refroidit la pellicule résultate dans un dispositif de refroidissement (21) à une température inférieure à 37,7 °C et on la recueille sur un cylindre de réenroulement (24).

2. Procédé de fabrication d'une pellicule polymérique à ouvertures ayant une texture superficielle et une douceur améliorées, dans lequel
   a) on introduit une pellicule polymérique à ouvertures dans un plan défini par les directions X et Y à partir d'un cylindre (11) en direction d'un cylindre de micro-gaufrage (13), ledit cylindre de gaufrage (13) étant chauffé et forcé contre un cylindre enclume (14),
   b) on refroidit ladite pellicule micro-gaufrée dans un dispositif de refroidissement (15) à une température inférieure à 37,7 °C,
   c) on introduit la pellicule à ouvertures avec micro-gaufrage dans un cylindre de macro-gaufrage (19) que l'on chauffe et qu'on force contre un cylindre enclume (20) sous une pression contrôlée pour donner un dessin prononcé à ladite pellicule, et
   d) on refroidit la pellicule résultante dans un dispositif de refroidissement à moins de 37,7 °C et on la recueille sur un cylindre de réenroulement (24).

3. Procédé selon la revendication 1 ou 2, dans lequel ladite pellicule polymérique à ouvertures est dilatée dans la direction Z à au moins deux fois son épaisseur unitaire d'origine par ladite étape de macro-gaufrage.

4. Procédé selon la revendication 1 ou 2, dans lequel ladite pellicule polymérique à ouvertures a une épaisseur unitaire d'origine comprise entre 0,025 et 0,762 mm (1 et 30 mils).

5. Procédé selon la revendication 4, dans lequel ladite pellicule polymérique à ouvertures a une épaisseur unitaire d'origine comprise entre 0,076 et 0,254 mm (3 et 10 mils).

6. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel ladite pellicule polymérique à ouvertures est choisie dans le groupe constitué par le polypropylène, le polyéthylène et un bicomposant polyéthylène/éthylène-acétate de vinyle.

7. Procédé selon la revendication 1 ou 2, dans lequel ladite pellicule polymérique à ouvertures comprend du polyéthylène et ladite température de macro- et de micro-gaufrage est supérieure à environ 65,56 °C (150 °F).

8. Procédé selon la revendication 7, dans lequel ladite pellicule polymérique à ouvertures est un polyéthylène/acétate de vinyle coextrudé ayant une épaisseur d'environ 0,114 mm (4,5 mils) et une surface moyenne d'ouvertures d'environ 40%.

9. Procédé selon la revendication 8, dans lequel la vitesse du cylindre de macro-gaufrage est réglée à environ 54,86 m/min (60 yards par minute), la pression au point de pinçage du cylindre est d'environ 39,4 kN/m (225 livres par pouce linéaire) et la température du cylindre est d'environ 76,67 °C (170 °F); et
   la vitesse du cylindre de micro-gaufrage est d'environ 86,87 m/min (95 yards par minute), la pression au point de pinçage du cyindre est d'environ 87,5 kN/m (500 livres par pouce linéaire) et la température du cylindre est d'environ 76,67 °C (170 °F).

10. Procédé selon l'une quelconque des revendications 1 à 9, dans lequel ledit dessin prononcé est un dessin de type textile choisi dans le groupe constitué par les dessins en traits croisés, en arêtes de poisson et en armure nattée.

11. Procédé selon l'une quelconque des revendications 1 à 10, dans lequel ledit cylindre de

micro-gaufrage comprend un dessin linéaire gravé.

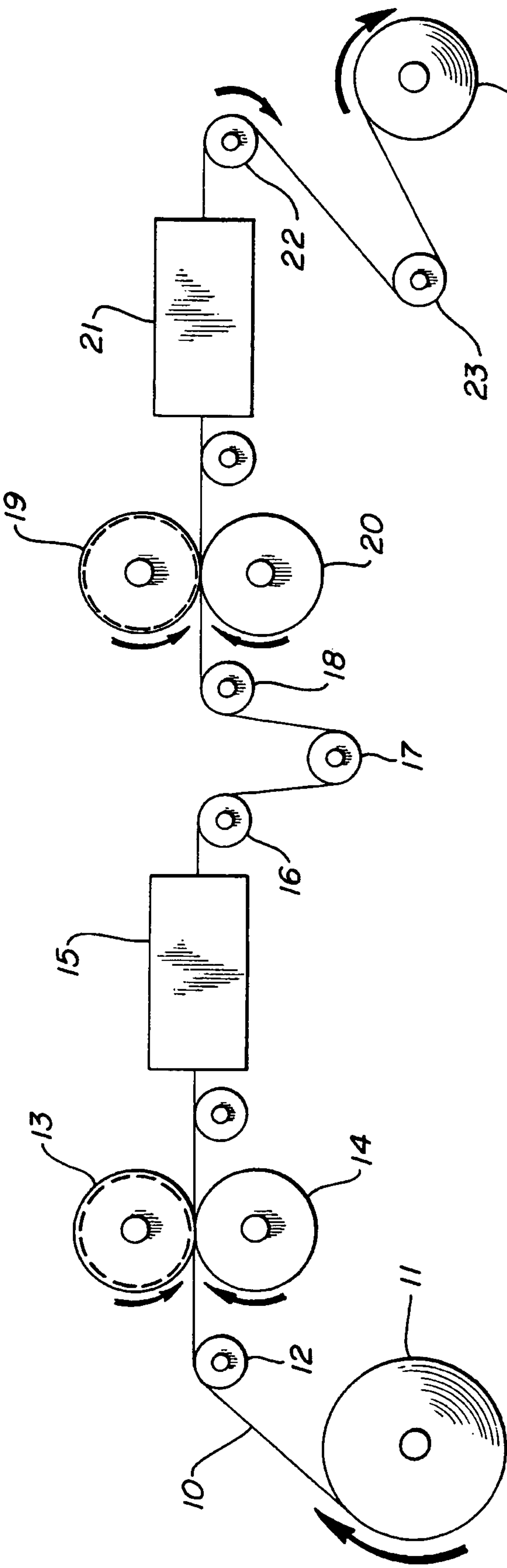

FIG-1

FIG-2

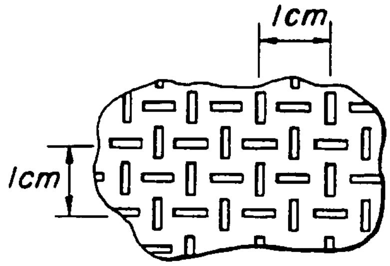

FIG-3

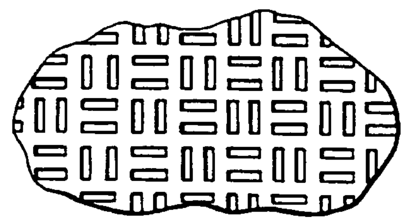

FIG-4

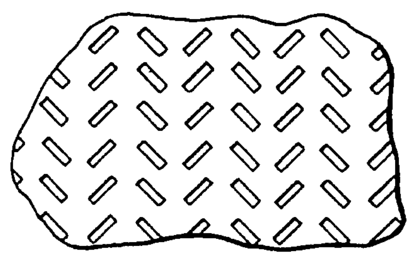

FIG-5

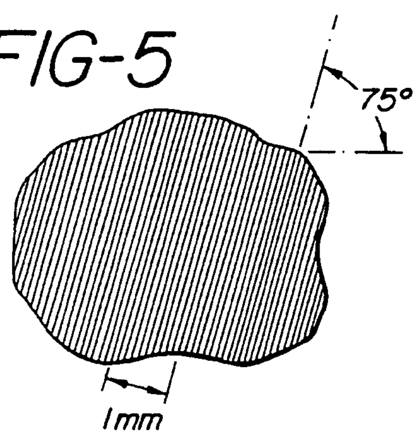

FIG-6

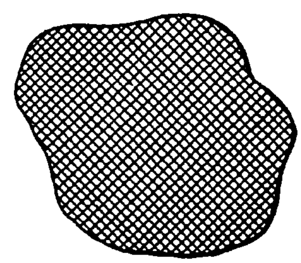

FIG-7

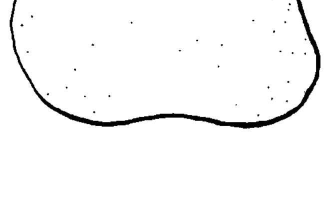

FIG-8

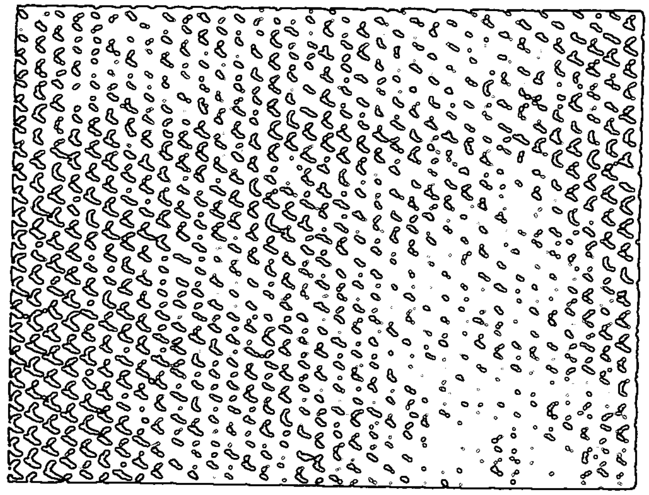

FIG-9